Directorate of
Intelligence

Secret

25X1

(6)

The Soviet Oceanographic Research Program

25X1

A Technical Intelligence Report

Secret

SW 84-10007
February 1984

Copy 269

25X1

The Soviet Oceanographic Research Program

25X1

A Technical Intelligence Report

25X1

This paper was prepared by [redacted] Office of Scientific and Weapons Research. Comments and queries are welcome and may be directed to the Chief of the Science and Technology Division [redacted] or the Chief of Naval Systems Division [redacted]

25X1

25X1

25X1

Secret
SW 84-10007
February 1984

25X1

The Soviet Oceanographic Research Program

25X1

Summary

Information available as of 1 November 1983 was used in this report.

The USSR has the world's largest oceanographic research program. This program is expanding and will provide the Soviets with military, economic, and political benefits. The Soviet research fleet of more than 200 ships now outnumbers that of the United States by more than 3 to 1.

25X1

Militarily, Soviet oceanographic efforts center on submarine operations and antisubmarine warfare (ASW). For example, because the performance of acoustic systems depends, in part, on local oceanographic conditions (salinity, temperature, sea-floor sediments, waves, background noise), the Soviets have collected extensive data on oceanographic conditions worldwide. They clearly hope to use this knowledge to help offset pronounced US advantages in acoustic submarine detection.

25X1

In military exercises, they occasionally have used their knowledge of local oceanographic conditions to greatly extend the range of their acoustic sensors. They have attempted to "hide" their submarines behind ocean fronts or eddies. And they are attempting to use their growing understanding of the Arctic environment in developing techniques to avoid detection and prosecution by US ASW forces. Other military applications of Soviet oceanography include submarine navigation, communications, mine warfare, and intelligence collection.

25X1

Economically, major advantages can be accrued from oceanographic research. The efficiency and yield of the large Soviet global fisheries fleet have been increased through an improved understanding of the dynamics of marine life. If the world becomes significantly more dependent upon the oceans for nutrition, the Soviet advances in this area could become significant. Furthermore, judging from Soviet research and technology acquisitions, we expect the Soviets to undertake extensive resource surveys and deep sea equipment development that will allow them to exploit economically vast mineral resources.

25X1

Of great importance also are Soviet efforts to study the interaction of the oceans and global weather. An understanding of these conditions should allow the Soviets to better forecast and perhaps even to influence the weather. This would have enormous consequences, particularly in agriculture and military operations.

25X1

Politically, the Soviets' global research program is valuable for exerting influence on Third World nations, which use Soviet support to exploit their ocean resources. The Soviets cooperate in multinational research programs to obtain otherwise unavailable data in foreign waters and to increase their prestige in the world scientific community.

25X1

25X1

The Soviets are eager to incorporate Western and Japanese instrument technology and scientific techniques into their own oceanographic R&D program. Among the technologies they have obtained legally are US navigation receivers, current meters, research ship components, automated analysis instruments, sensitive salinity and temperature profilers, data-processing equipment, and manned submersibles.

25X1

The quality of Soviet oceanographic research varies widely between research organizations; some efforts are equal to those of the United States, while others are primitive. The strongest civilian efforts seem to be in theoretical ocean dynamics to support both ASW and weather research. In general, the quality of many Soviet efforts is improving at a rate that could make them the world leaders in most fields of oceanography.

25X1

Oceanographic study from space, which worldwide is in its infancy, could revolutionize oceanography by drastically increasing the amount and kinds of data available. The Soviets have boasted that they would have a dedicated multisensor oceanographic satellite in orbit in the early 1980s and, eventually, a network of satellites to monitor the oceans constantly. However, we do not expect such a system before the mid-1980s. Soviet researchers have stated that the USSR has the long-term goal of developing a worldwide network of buoys with subsurface oceanographic sensors that could relay data to ground stations by satellites.

25X1

Satellite-collected data on the surface of the ocean, with measurements made in ocean depths from buoys and ships, could be processed by a large central computer center to provide near-real-time forecasts for weather. Other data would have value for fisheries, military systems, and a wide range of other ocean uses. We do not believe the Soviets will be able to achieve this goal before the 1990s.

25X1

Contents

25X1

The Soviet Oceanographic Research Program

25X1

Introduction

Oceanographic research is still in its infancy—as more research is done, the need to do still more becomes apparent. The oceans that cover nearly three-fourths of the earth's surface control weather patterns, the oxygen and carbon dioxide balance of the atmosphere, and precipitation. The oceans also are important for transportation, food, national security, and increasingly for minerals and energy.

25X1

Soviet leaders are aware of the importance of ocean research, and their commitment is greater than that of any other nation. In the early 1960s, the Soviets began a large expansion of their oceanographic research program, especially in research ships and manpower. The Soviet research fleet now outnumbers that of the United States by more than 3 to 1.

25X1

The quality of Soviet oceanographic instrumentation often has lagged that of Western instruments by several years. For example, the Soviet fleet has not been as well-equipped as the US fleet. Sophisticated instruments are not necessary for all types of oceanographic research, however, and the larger number of ships allows the Soviets to conduct more military and civilian (including economic) ocean research than the United States.

25X1

Soviet oceanographic research appears to be goal-oriented and its high-level support is reflected in both funding and manpower. At the 14th Pacific Science Congress in 1979, Academican A. V. Sidorenko, vice president of the USSR Academy of Sciences, stated that study of the world oceans had risen to the level of a state objective. The ranking Soviet naval officer, Admiral of the Fleet Sergey G. Gorshkov has written extensively on the benefits of military and civilian research. Admiral Gorshkov has said "the major navies of today are technological equals—that navy possessing a superior knowledge of the environment and knowing how to take tactical advantage will be the victor." Gorshkov also has pointed out that although the USSR already is conducting a large volume of oceanographic research, the effort needs to be expanded.

25X1

This paper gives an overview of the Soviet oceanographic research program, which covers a wide range of research including physical oceanography, hydroacoustics, marine geology and geophysics, and polar research. Our treatment of individual research areas is necessarily brief, but we have attempted to identify the strengths and weaknesses of the Soviet program. Areas of Soviet oceanographic research that could substantially increase Soviet military, economic, political power are described. The topic of Soviet oceanographic research may require more detailed intelligence analysis.

25X1

Soviet Oceanographic Research Platforms

The Soviets have a large and increasing number of platforms, including ships, submersibles, and a variety of manned and unmanned satellites. The Soviets have used these platforms to complete the existing data base, concentrating on geographic areas of strategic and economic importance (figure 1).

25X1

Oceanographic Research Fleet

In their military and civilian fleets the Soviets have over 200 large oceanographic research ships and about 100 fisheries research ships.

25X1

many of these ships are poorly outfitted for oceanographic research. Some are converted fishing, passenger, or cargo ships. The Soviets, however, are rapidly upgrading their fleet with new ships designed specifically for oeeanographic research (figure 2).

25X1

The new ships tend to be large (over 100 meters) and able to carry a large number of scientists for months at a time. The ships usually are designed with numerous laboratories, allowing research in many oceanographic disciplines during a single voyage. Many of

the new ships have an integrated computer system that is used in most of their research activities. Each ship's navigation systems, laboratory instruments, and oceanographic sensors are linked into the system for reduction, storage, and processing of oceanographic data. We estimate that similar ships built in the United States would cost $20 to $50 million each, and the operating cost for each ship would be $12,000 to $20,000 per day.

25X1

25X1

Navigation Systems

For many types of research in the open sea, a ship must know its position at all times; this accuracy generally requires satellite navigation systems. Although the Soviet military has had such systems since the mid-1960s, the Soviet oceanographic fleet during the early 1970s purchased its first satellite navigation receiver, which had been manufactured by Magnavox for use with the US NAVSAT. Although Soviet-built satellite navigation systems were available by the late 1970s, the Soviets have continued to use US and other Western satellite navigation receivers, in addition to their own.

25X1

Oceanographic Research Equipment

According to US scientists familiar with the Soviet program and our analysis of Soviet results reported in open literature, we judge that the Soviets have made major improvements in their oceanographic technology and instrumentation, but they still lag the United States in many areas. In certain cases, their lack of sophisticated oceanographic instruments results in a greater expenditure of manpower, ships, and equipment than in US research efforts. Some researchers in the Soviet fishery community use crude mechanical instruments developed before World War II. On the other hand, the Soviet Institute of Oceanology uses sophisticated electronic instruments comparable with those used in the United States. The electronic instruments provide more accurate and rapid measurements, which are fed into shipboard computers for processing and storage. Many Soviet-produced instruments are adequate to perform the general oceanographic surveys necessary for future exploitation of the oceans. We believe improvements will include computer-automated multisensor instruments and data processing.

25X1

Much of our knowledge of the Soviets' oceanographic research capability comes from their civilian research institutes. these institutes receive some funding from the Navy and probably give the Navy all data collected of military interest. closed departments at civilian oceanography institutes work on classified naval projects. The Soviet Navy has a large fleet of hydrographic ships to collect data in support of Navy programs, but we know little of their activities. (C)

25X1

25X1

We do not know exactly how much instrumentation and research methodology are exchanged between the civilian and naval oceanographic communities, but communication and cooperation between the various Soviet civil institutes involved in oceanography often are poor. This sometimes results in vast differences in the quality and sophistication of instruments at the various institutes. The Academy of Sciences has the largest and most modern oceanographic research ships in the Soviet Union, but in certain areas, the Navy has technology and resources unavailable to the civilian oceanographic community.

25X1

25X1

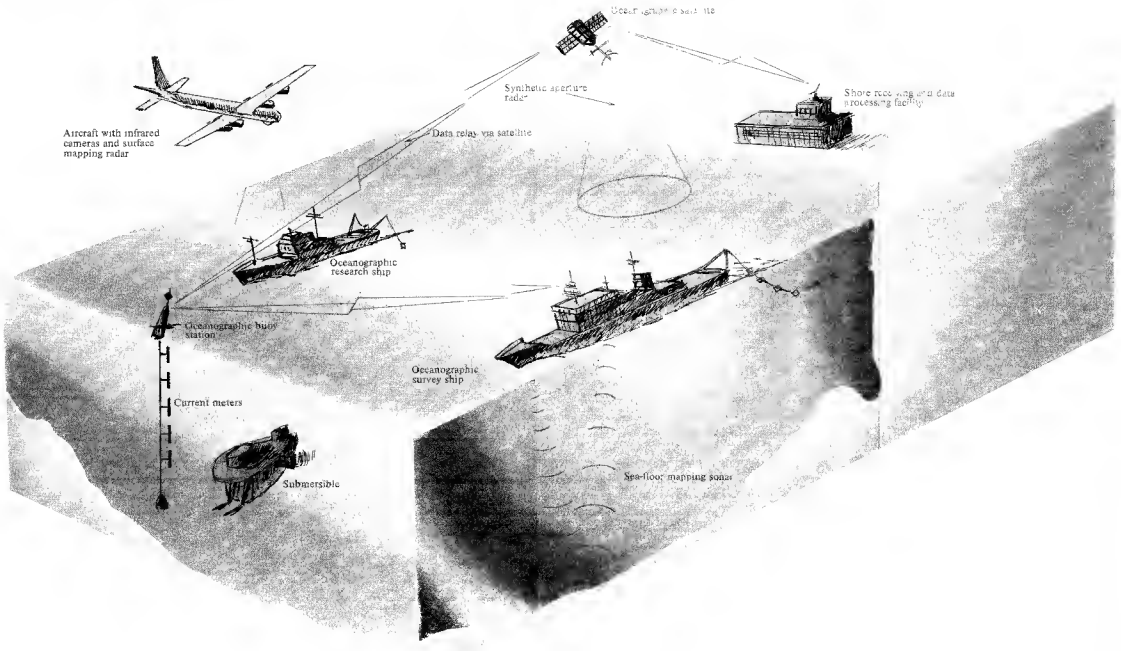
The lack of good oceanographic instrumentation in the research fleet has been most evident in joint US-USSR research efforts, where Soviet and American instruments could be compared. The Soviets, who are well aware of their instrument deficiencies, use every opportunity to incorporate US technology and instruments into their oceanographic research. Soviet attempts to purchase US equipment lead us to believe the Soviets have little difficulty in obtaining the funding for sophisticated US equipment when it is available, but sometimes they cannot obtain funding to purchase spare parts.

25X1

Equipment Limitations. The Soviets do not have some instruments useful in oceanographic research, but in most cases they have adequate substitutes. For example, instruments for automated chemical analysis of seawater

25X1

Figure 1
Oceanographic Data Collection System



25X1

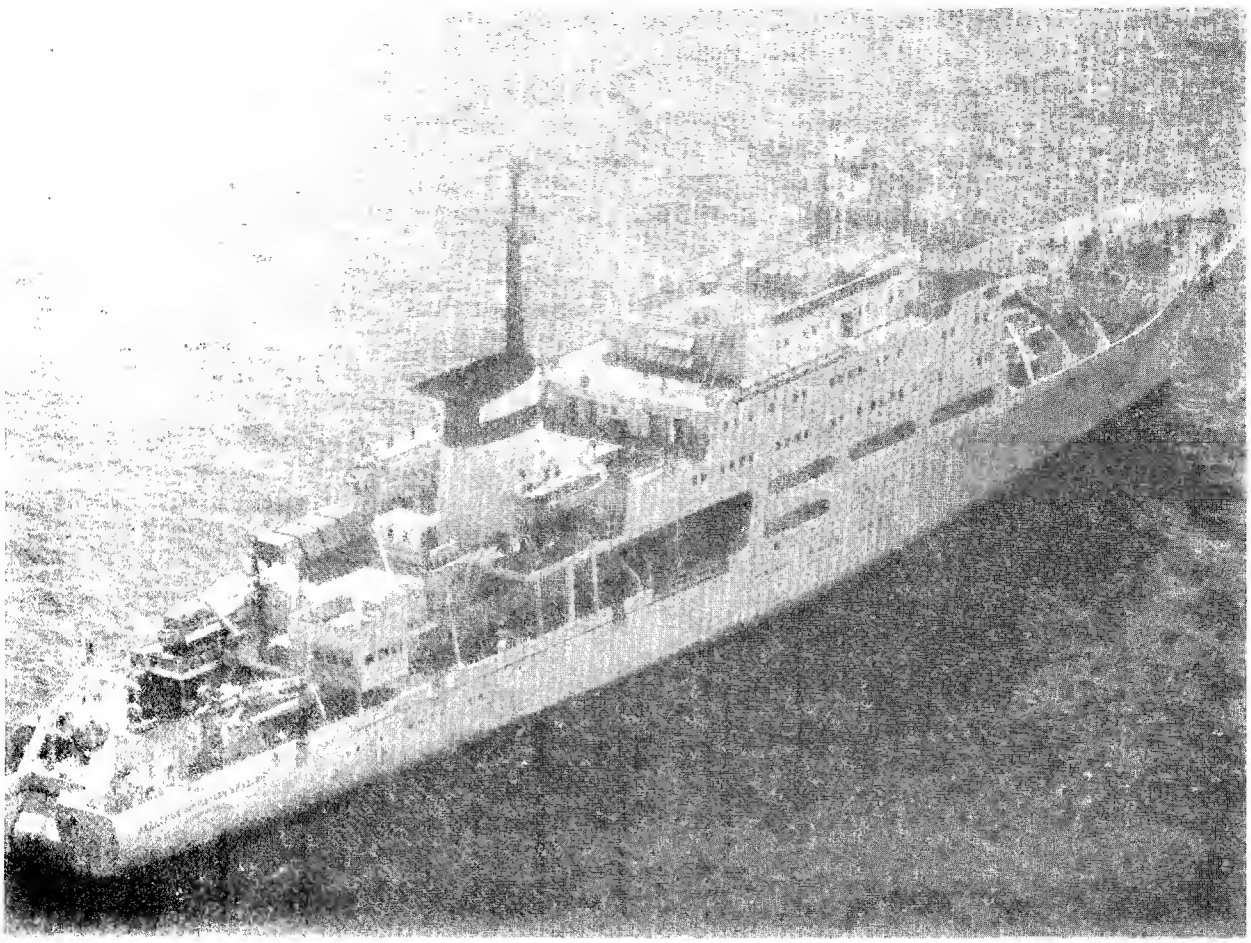


Figure 2. The Flagship of the Soviet Research Fleet, the Akademik Mstislav Keldysh, which was built under contract in Finland.

25X1

generally are in short supply in the Soviet Union. The Soviets can obtain such equipment from Western sources, but it is very expensive and usually requires much technical service not readily available in the USSR. As a result, the Soviets tend to rely more heavily on slower test-tube analysis. These methods can be sensitive and reliable, but, because they are extremely time-consuming, the amount of data that can be collected is greatly reduced.

25X1

The Soviets have often had problems with the basic technology of materials and hardware. For example, they have encountered difficulties in producing oceanographic buoy systems that can be anchored at all ocean depths, can withstand storms at sea, and can stabilize a sensor string by isolating it from wave motion. The Soviets have found the engineering technology for deploying oceanographic instruments on the high seas to be readily available from the West and Japan.

25X1

Expendable Bathythermographs. Expendable bathythermographs (XBT) are used to take profiles of water temperature versus depth; these in turn are used to develop sound-velocity profiles necessary for the optimal use of sonar systems. An expendable XBT allows on-the-scene environmental data to be collected from

a moving ship. A specially configured XBT (AXBT) can be airdropped and monitored from an aircraft. Both XBT and AXBT systems can gather much more data than by conventional methods.

The US Navy uses both XBTs and AXBTs. By airdropping a pattern of AXBTs, US researchers can study large ocean areas quickly. Also, dynamic features such as the positions of the meanders and eddies of the Gulf Stream can be studied synoptically (like a snapshot). The United States has other, expendable systems for oceanographic research, including an ocean-current profiler (XCP) and a sound velocimeter (XSV).

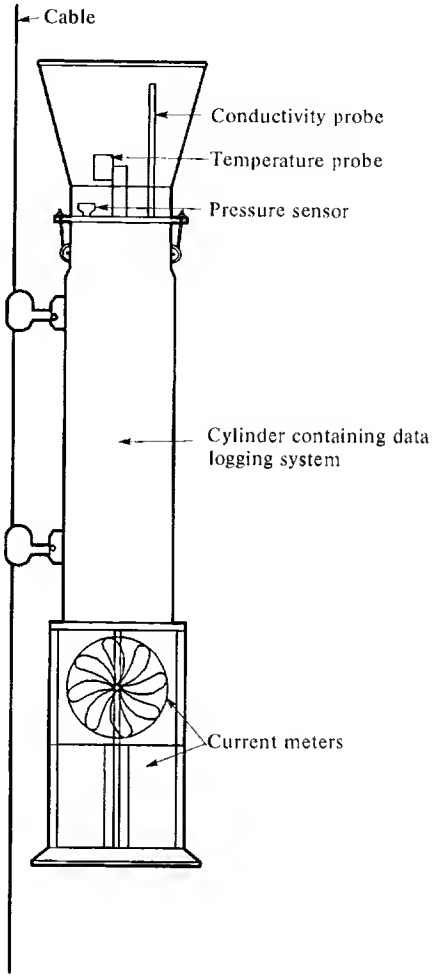
The Soviets have developed an XBT, but it is not yet in widespread use. Soviet scientists have reported difficulties with the technologies to make the very long and thin insulated data transmission wire. (As noted later, the Soviets have used US equipment in a cooperative program.)

The Soviets' have ship-towable mechanical bathythermographs that were developed before World War II. These do not provide accurate data. To routinely collect temperature data similar in quality to XBT data, Soviet research ships must stop while they lower a temperature probe into the water. To cover large areas at once, numerous research ships must each deploy and later recover a number of large oceanographic buoys. A string of temperature sensors hang beneath the buoys to monitor the water temperatures.

in 1982 a Soviet Bear-F ASW aircraft used a new Soviet-designed, airdropped expendable sound velocimeter sonobuoy (AXSV). We believe this sonobuoy is operational or in the final stage of research and development. We expect the Soviet Navy to use the system to provide environmental support for new low-frequency sonobuoys, although as yet no system of this sort is known to have been used by the Soviets for oceanographic research.

Ocean-Current Meters. The Soviets have developed many types of ocean-current meters that, in general, are adequate for measuring general ocean currents (figure 3). More advanced oceanographic research of the dynamics of ocean mixing—involving measurements of weak ocean currents—would require more sensitive meters, however.

Figure 3
Soviet ANSITT Current Meter



589942 2-84

Data from Soviet current meters were exchanged as part of joint US-USSR research efforts during the 1970s. The Soviet data differed significantly from US data. Although the Soviets have made a concentrated effort to upgrade their current meters since then, their data from 1981 calibration tests provided to the United States show that their current meters are still behind in reliability and precision. However, some Soviet scientists have stated that they no longer need to purchase such equipment from the United States.

25X1

Probes for Conductivity and Temperature. We know the Soviets have developed different probes for measuring conductivity, temperature, and depth (CTD). These probes are standard oceanographic instruments that also are used for studying dynamic ocean processes, such as turbulence and internal waves.[1] A lack of standardization and calibration has caused problems with the data from some Soviet CTDs. Although the Soviets are technically capable of producing good CTD instruments, we believe they still prefer Western CTDs, because they continue to purchase them.

25X1

Data-Processing Equipment. Real-time digital electronic processing and analysis of acoustic signals are critical to advanced hydroacoustic research. The Soviets continue to lag the United States in producing sophisticated electronic equipment for this type of processing, although they have made significant progress in recent years. They also are making advances in optical methods of signal processing that could alleviate some of their signal-processing problems.

25X1

However, to use these data properly, the Soviets will need shore-based computer systems, computer programs, data management networks, and data distribution systems. We believe that improved methods of data collection will require upgrading Soviet computer capability for many years. Improved computer capabilities will allow the processing, analysis, and application of more of the collected data. This, in turn, may lead to the development of more sophisticated models and solutions to many complex oceanographic problems.

25X1

[1] An ocean internal wave is one that occurs within the water—not at the surface, as with wind waves. Internal waves can occur in waters where the density changes with depth. Such changes mostly result from temperature changes. The stronger the density change, the more likely internal waves will be formed.

25X1

The Soviets in recent years have improved their computer capability to analyze the vast amounts of data collected by their large research fleet. In 1975 the Soviet scientific literature reported the development of a shipboard analog to digital data processing complex, using a Minsk-32 computer. This system has been put into production, but the bulk of the processing apparently still is done at shore facilities.

25X1

the Soviets are working to develop a fully automated shipboard system for recording and for primary processing.

25X1

several East European countries in cooperation with the Soviets have developed a state-of-the-art system; this will soon be ready to be marketed. It appears to be comparable with Western processing systems, but it could be unreliable for some years.

25X1

25X1

Submersibles

The Soviet civilian oceanographic community has had to go abroad to obtain many deep-diving research submersibles. the Soviets have purchased two Pisces manned submersibles with a depth capability of 2,000 meters. They have attempted to obtain a submersible with a 6,000-meter-depth capability (figure 4).

25X1

25X1

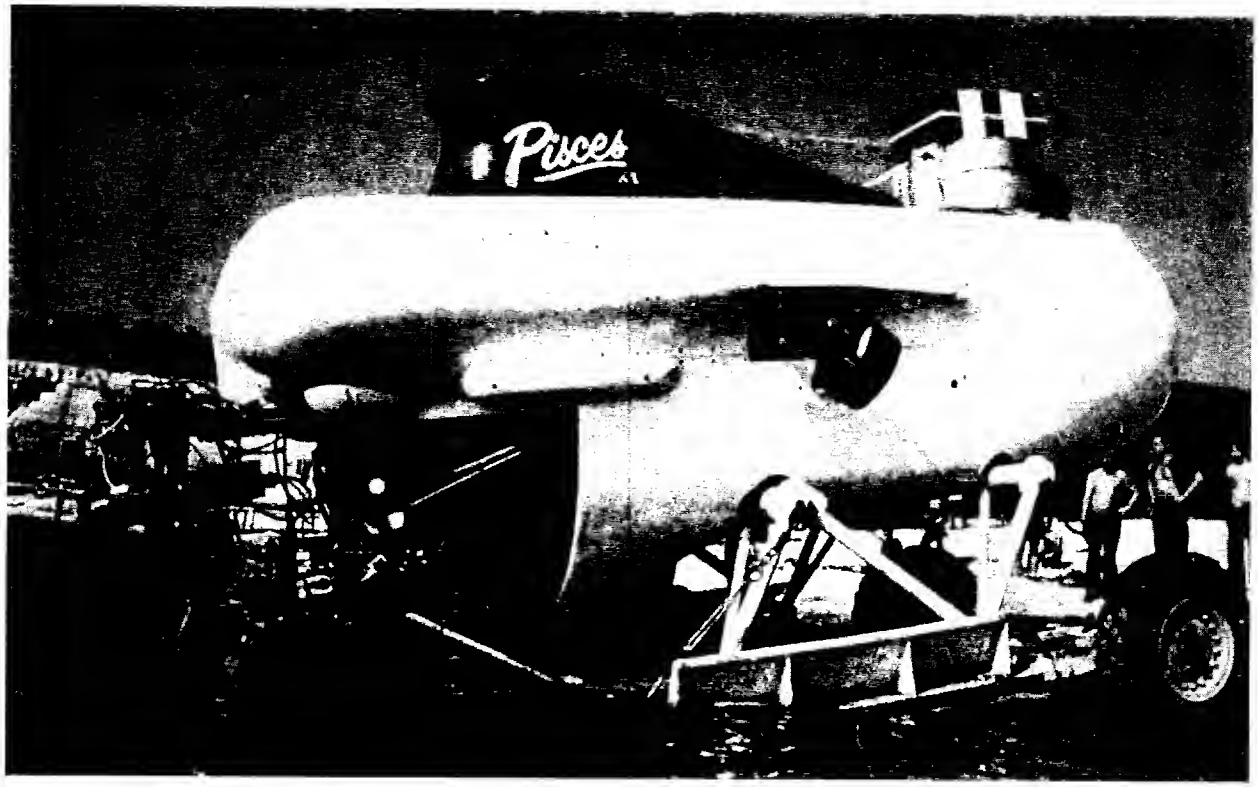
25X1

The Soviet Navy has an extensive submersible program that Soviet civilian oceanographers have indicated is separate from the civilian program. Although we do not know the depth capability of the Navy submersibles, we know the Soviets can produce high-pressure hulls for deep-diving submersibles.

25X1

The Soviets have installed side-scanning sonars on some submersibles for navigating and for searching for bottom features. With this type of sonar, the submersibles can be lowered close to the ocean bottom to obtain high-resolution images. On recent cruises, several new research ships have employed Soviet-made Zvuk-4 and Krab unmanned submersibles. These are designed to carry out geological observations of the ocean bottom, the Zvuk by means of a side-scanning sonar and the Krab by cameras and television.

25X1



25X1 *Figure 4. Pisces Submersible.*

Submersibles also can obtain samples of the ocean bottom and, in general, are a valuable tool for marine geology research. They allow biological life to be studied in its habitat, rather than as samples in the laboratory. The activities of Soviet civilian submersibles could provide a natural cover for military activities, such as emplacing ASW sensors, recovering hardware, and locating and examining US ASW sensors.

25X1

Satellites

Early in the space program, Soviet scientists began to recognize the potential of satellites for oceanography. Satellites permit vast areas of the world's oceans to be studied and repeat measurements to be made over a short time. Satellites are the only means of comprehensively observing all the world oceans within a short period, but, because satellites generally are restricted to observing the surface of the ocean, they cannot replace observations from ships and instrumented buoys.

25X1

The Soviet military is interested in using oceanographic satellite sensors to study ocean phenomena to support ASW and submarine operations. They may believe—based partially on the success of the US Seasat oceanographic satellite in observing such phenomena—that enemy submarines can be discovered by observing their disturbances.

25X1

Satellites of Opportunity

The Soviets began their satellite oceanography in the 1960s with data from the Meteor weather satellites and from manned spacecraft. The first generation of Meteors provided imagery in the visible wavelengths, as well as radiometer observations in the infrared and the microwave wavelengths. These observations gave useful information on the temperatures of the ocean's surface, sea-state and related surface wind conditions, ice conditions, and ocean pollution. Most of the measurements were of low resolution, however, and

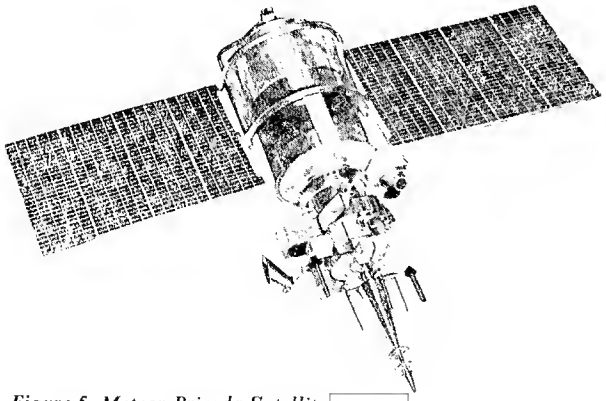


Figure 5. Meteor-Priroda Satellite

25X1

probably did little more than whet the appetite of Soviet scientists for information focused more directly on the needs of oceanography.

25X1

25X1

The manned space program also has made oceanographic observations.

25X1

Salyut 6 was expected to provide information on the structure and dynamics of the ocean layers and currents, the concentration of living organisms in various ocean areas, and the chemical composition of the water.

We believe that the Soviets will expand their use of their manned space program to make oceanographic observations, but we do not believe that manned spacecraft will replace unmanned, dedicated oceanographic satellites at least in the next 10 years.

25X1

Dedicated Oceanographic Satellites

Cosmos Oceanographic Satellites. Only one dedicated oceanographic satellite is now active. The first, Cosmos 1076, was launched on 12 February 1979 and the second, Cosmos 1151, on January 1980. The Institutes of Marine Hydrophysics (MGI), Radio Engineering and Electronics, and Oceanology reportedly developed the instrumentation for these satellites. The latest oceanographic satellite, Cosmos 1500, was launched on 28 September 1983. Two other oceanographic satellites also have been launched: Intercosmos 20 on 1 November 1979 and Intercosmos 21 on 6 February 1981. The difference in the objectives between these Cosmos and Intercosmos satellites is unclear. Scientists from several East European countries have participated in providing instrumentation for the Intercosmos vehicles, whereas Cosmos oceanographic satellites are all-Soviet ventures.

25X1

Cosmos 1076 and 1151 apparently carried similar, if not identical, payloads. According to an interview with B. A. Nelepo, Director of MGI, Cosmos 1076 carried instruments to assist ocean navigation and fishing by determining color and temperature anomalies of the ocean surface. A Soviet press announcement referred to Cosmos 1151 as a "younger brother" of Cosmos 1076 and mentioned that it had an additional radar for collecting information about the magnitude of ocean waves.

25X1

25X1

25X1

25X1

25X1

25X1

25X1

Press reports stated that data transmitted to central reception centers included wind speed at the surface, as well as temperature and salinity at various ocean depths. Such data can provide ground-truth information to compare with data from the satellite sensors, and the data from beneath the ocean surface can complement the satellite measurements. Soviet oceanographers have stated that they are developing a worldwide network of ocean buoy stations. This network would allow constant monitoring of the oceans and should significantly increase the value of the satellite data for scientific analyses, as well as for military-related work such as ASW.

25X1

Intercosmos Satellites. The main mission of Intercosmos 20 and 21, according to Soviet reports, was to test the data relay system developed jointly by Hungary, Czechoslovakia, East Germany, and the USSR.

Intercosmos 21 and Cosmos 1151 have been active simultaneously. The Soviet press has reported that the Marine Hydrophysics Institute already has produced charts of large areas of the world's oceans, based on observations from these two satellites. The Soviets also have stated that the MGI research ship Akademik Vernadskiy would incorporate data from Intercosmos 21 and Cosmos 1151 in its summer and fall 1981 operations in the Indian and southwest Pacific Oceans.

25X1

25X1

Prospects for Satellite Oceanography

The initial Soviet program in satellite oceanography seems to have been well conceived. The instrumentation aboard the satellites does not appear to push the state of the art, but simultaneous measurements by ships and buoys will upgrade the usefulness of such data for oceanographic research.

25X1

25X1

The Soviets have ambitious plans for satellite oceanography. Several responsible Soviet scientists have stated that in the near future the USSR will launch satellites comparable with Seasat. The first satellite will be under the control of the State Committee for Hydrometeorology and Control of the Natural Environmental. Such satellites probably will be part of the Meteor-Priroda series of earth resources satellites, and this program may be similar to the now canceled US program for a national oceanic satellite system planned for the mid-1980s. The Soviet schedule has slipped, but we believe the first of these satellites will be launched in the mid-1980s.

25X1

25X1

Soviet scientists have stated that each of the new satellites will carry a radar altimeter, radar scatterometer, and a microwave radiometer to measure wind speed and direction, sea surface temperature, and wave height, as well as the elevations and depressions of the sea surface. Although nothing was mentioned about measurements in the visible and infrared, we believe such observations also will be made.

25X1

25X1

25X1

Oceanographic Research Program

Oceanographic research provides essential information for improving surface and subsurface navigation, for producing sonar charts and atlases, and for developing undersea-warfare techniques. ASW sensors are highly dependent on knowledge of the oceanographic environment for their effectiveness. 25X1

While the Soviet Navy has wide-ranging interest in oceanographic research, its primary interest is in submarine operations. The Navy has its own research fleet, but it also uses data collected by the civil fleet to support its operations. 25X1

Soviet oceanographic research supports merchant marine operations in many ways, including navigation and forecasting of optimal ship routes; the Northern Sea route, in particular, requires extensive support. The USSR is interested in the oceans as a food source, because historically it has been short of meat protein. New ocean sources of minerals and energy, especially oil and gas, also are of vital interest. Finally, the oceans exert a significant influence on the weather and climate. Because the weather is often poor and can be harsh in the best of years, the Soviets are eager to understand the relationship between oceans and climate to better predict and possibly to modify the weather. 25X1

Physical Oceanography

Physical oceanographic research is the discipline most closely linked to ASW. Prediction of the oceanographic environment is important for the proper use of ASW sensors, as well as for other naval operations. Large amounts of such data have been collected on all of the world's oceans through the extensive Soviet program and from the Soviets' access to much US data. 25X1

Soviet efforts to collect data worldwide are much more extensive than those of the United States. For example, the Soviets are doing much work in the oceans of the southern hemisphere; in the Indian Ocean they are devoting as many as five ships to data collection. In comparison, US researchers hope to have one ship spend several months there annually. Data collection in such potentially strategic military areas will certainly give the Soviets the edge in tactical use of the environment by naval forces. 25X1 25X1

Soviet oceanographers are very interested in modeling the dynamic processes in the ocean—including circulation, water mass formulation and mixing, turbulence, and variability—and are working on theoretically advanced multiparameter ocean models. Most large-scale, computer-based models of the ocean are limited in the USSR, as they are in the United States, by insufficient quantities of data. Models of small-scale processes often are handicapped by the lack of sufficiently accurate fine-scale time series measurements. 25X1

Understanding these phenomena has both civilian and military applications. For example, the variability in the temperature-salinity structure between currents and water masses affects the propagation of sound. Thus, it is of interest for ASW. Also, ocean turbulence and internal wave studies are important in nonacoustic ASW. Because the heat exchange between oceans and atmosphere greatly affects weather, dynamic oceanography interests both civilian and military meteorologists. The distribution of marine 25X1

life, nutrients, and pollutants by dynamic ocean processes is of critical importance to personnel in the fishing industry.

25X1

25X1

25X1

the Marine Hydrophysics, Oceanology, and Acoustics Institutes all are active in Navy-sponsored internal wave research. These investigations generally have been based on observations from ships and buoys, but interest is increasing in remote sensing from space.

25X1

25X1

the Institute of Oceanology conducts ocean-turbulence research, some of which is for the Navy. The research reportedly ranges from technical reviews and assessments of field work to active investigations to distinguish turbulence caused by submarines from natural background turbulence. The Institute of Oceanology also carries out laboratory experiments to study the movement and collapse of turbulent ocean patches. The Marine Hydrophysics Institute does extensive ocean turbulence research, including developing instrumentation for the Navy and collecting data related to marine turbulence. Reportedly this institute is extensively involved in military research.

25X1

The Soviet Navy is studying the thermocline, primarily because of its effect on sound propagation. Research includes collecting worldwide data in temperature profiles to map and to predict the thermocline, which changes in depth, spatially and seasonally. This research is supplemented by sound propagation studies to determine the effects of the thermocline on sonar systems.

25X1

Members of a Soviet research group believed that the subproject to which they were assigned had as its goal communicating from aircraft or satellite to submarines. We believe the work may have supported development of a communications or ASW detection system, but we have no indication whether this research will lead to an operational Navy system.

25X1

The group, headed by K. S. Shifrin of the Leningrad Branch of the Institute of Oceanology, in 1976 to 1977 was given a project sponsored by the Navy but apparently initiated through the State Committee for Hydrometeorology and Environmental Control. The project probably was part of a larger project the Navy had with the State Committee. The technical specifications of the subproject were vague but seemed to involve the study of cloud patterns over the world's oceans to determine their effects on laser propagation.

25X1

The study of ocean-water optics is important to both Soviet biologists and the Navy, because such properties help to determine productivity of marine plants through photosynthesis. The Soviets are experimenting with airborne laser systems and probably with other optical devices for submarine detection.

25X1

25X1

Analysis of the scientific literature,

indicate that Soviet efforts surpass those of the United States in other areas of physical oceanography. For example, the Soviets are studying tsunamis (tidal waves) to which the Pacific Coast of the Soviet Union is susceptible. The Soviets hope to understand their formation and thus to be able to predict and to detect them in advance. The formation, types, and physical properties of sea ice also are of great interest to Soviet civilian and Navy researchers.

25X1

25X1

Oceanographic satellites should greatly enhance the Soviet capability to carry out surveys and to conduct physical research. These satellites may aid in developing spaceborne ASW sensors capable of detecting the changes submarines cause in the physical oceanographic environment. The satellites can detect features—such as fronts, eddies and currents—that could be used to make acoustic detection of Soviet submarines more difficult.

25X1

Marine Geology and Geophysics

An important application for marine geological and geophysical research is exploring for oil, gas, and minerals. Nearly 25 percent of all the world's petroleum is produced from ocean areas. Exploration for additional promising areas is still far from complete.

Placer deposits of solid minerals have been found in the continental shelf areas. Iron-manganese and phosphate concentrations—as well as ore-bearing ooze and brine—have been discovered in the abyssal zones. Recent US and Soviet discoveries of polymetallic sulfides near deep sea hot spots, mainly along the rift valleys of the Pacific Ocean ridges, show promise of containing rich concentrations of valuable metals such as silver, as well as manganese nodules that also may contain copper, nickel, and cobalt. We believe that much of the Soviet research in the continental shelf region is of interest to, if not directly supported by, the Navy, although the research ostensibly is directed toward discovering oil, gas, and mineral deposits.

25X1

Marine geological and geophysical research also is important when applied to other areas of concern, such as ocean pollution and burial of radioactive waste. Industrial wastes, as well as oil spills, can be extremely harmful to marine life. Even a thin film of oil over a relatively large area of the ocean's surface can affect heat transfer and evaporation into the atmosphere and ultimately can affect the weather. Several years ago the deep trenches of the ocean were considered as burial sites for radioactive waste. The deep trenches have been found to be very active seismically, however, and thus would not be suitable. The world's scientists now believe that certain abyssal plains of the ocean floor may be suitable, but further investigation is needed to verify the safety of widespread ocean dumping of radioactive waste.

25X1

Seismic Research

To carry out marine seismic research, an energy source is required, with sensors to receive the energy reflected from the ocean bottom and from sedimentary layers below. Originally, explosive charges were the energy source, but gas or air guns and electrical sparkers are used more often today. Gas guns, a larger energy source, are best for deeper penetration of the sediments. Air guns and sparkers have shorter pulse lengths that allow seismic signals at higher repetition rates. To receive the reflected signals, hydrophones can be emplaced on the ocean bottom or suspended at some depth from buoys. In the normal procedure, however, a surface ship tows an array of hydrophones, called a marine seismic streamer.

25X1

In principle, the same techniques can be used to locate submarines, exeept that the submarine becomes the source of energy received by the hydrophone array. Certain other differences exist between seismic array technology and ASW towed array technology: Usually the hydrophone arrays for ASW are shorter than seismic arrays, and the signal is processed somewhat differently. Seismic data normally are recorded for analysis later in a shore-based laboratory, whereas ASW signal data normally would be processed in real time. While seismic arrays generally would not be suitable for ASW purposes, the technologies are very similar.

25X1

Seismic profiling was a large step forward in marine seismic research. An ability to make observations while a ship is under way greatly increases the area over which surveys can be made. Most oceanographic surveys are made at speeds of 8 to 10 knots. Because many of the larger Soviet research ships do not operate efficiently at speeds under 12 to 15 knots, the Soviets have developed a system capable of operating at higher speeds, reportedly without generating a lot of self noise and with a penetration of 2 to 3 km into sedimentary ocean strata (figure 6). To do this, Soviet scientists claim to have developed improved sound sources, towing systems, and noise-immune receivers. With these, the Soviets have surveyed the East Indian ridge and adjacent basins in the Indian Ocean, rift zones, and transform faults in the central Atlantic and southeastern Pacific, as well as portions of the Barents and Okhotsk Seas. Some of these surveys probably supported prospecting for oil and gas reserves; others better defined the structure of the ocean crust in geophysically active ocean areas.

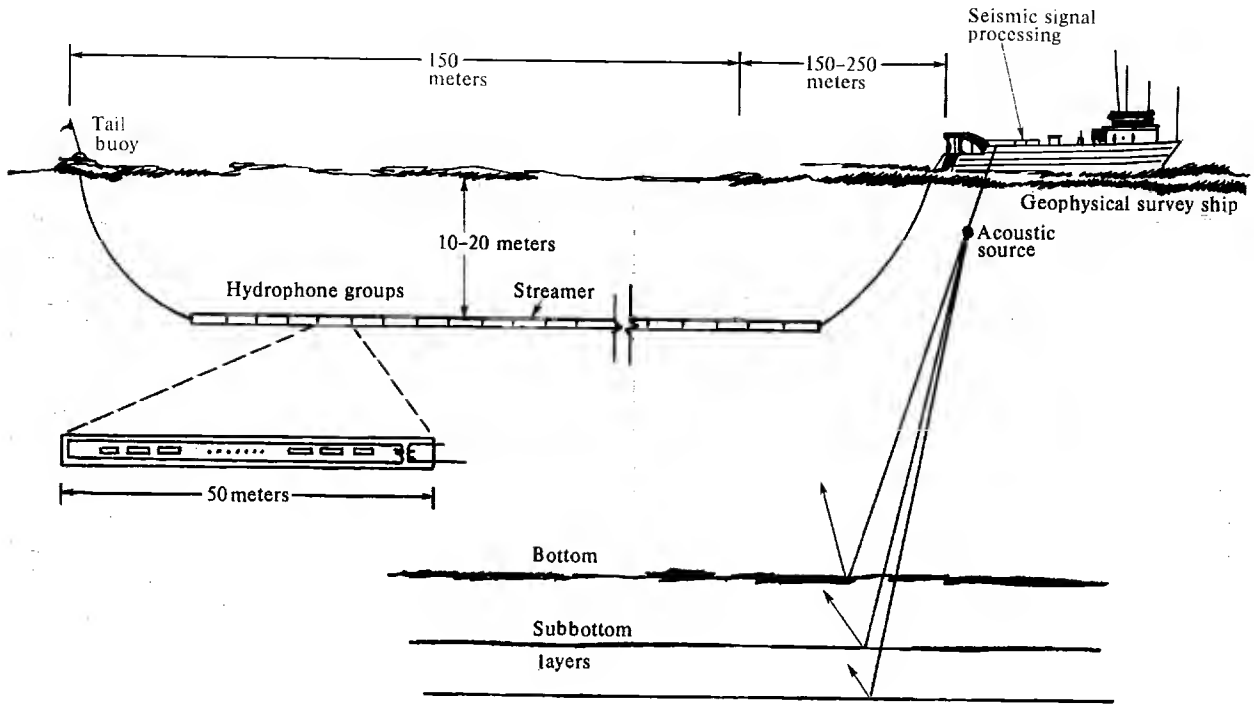
25X1
25X1

As noted, data processing long has been a problem for the Soviets, and marine seismic research is no exception. A few years ago, we estimated the Soviets lagged by four to 10 years Western civil technology in digital marine seismic data processing. While they have made progress since then, we doubt they have narrowed the gap by more than a year or two.

25X1

25X1

Figure 6
Elements of an Array for Seismic Profiling



589943 2-84

25X1

Gravimetric and Geomagnetic Research

The Soviets also are active in other types of marine geophysical investigations, the most common of which are gravity and geomagnetic. Both are used to study the ocean bottom and the structure of the earth's crust under the ocean. Magnetic measurements played a large part in developing the plate tectonic theory, and both gravity and magnetic observations are used in locating potential areas of mineral deposits. Geomagnetic measurements provide information on variations in the earth's magnetic field, the background against which magnetic methods for submarine detection must operate. Precise gravity measurements can be used to develop accurate mathematical models of local gravity in the launch region. Such models could aid SSBN navigation and help reduce SLBM targeting error. We do not know whether the Soviets compensate for local gravity errors in their SLBMs, but, as the accuracy of their SLBMs is improved, their need for precise gravity measurements in launch regions probably will be increased. [redacted]

25X1

The Soviets have continued their large effort to collect marine gravity data by using surface ships, submarines, and aircraft. Early in this research program, they had problems developing both the gravity meters and the gyrostabilized platforms needed to operate the instruments. Serious defects in the gyrostabilized platforms apparently were corrected in the early 1970s. We believe the Soviets' motivation for gravity research is the importance of such data to their SSBN fleet. Because of this importance, the Soviets probably

will continue to improve their instrumentation and to expand their program of marine gravity surveying. 25X1

Although geomagnetic measurements can be made on land to accuracies of 1 to 2 gammas and better, Soviet scientists claim accuracies of only 10 to 20 gammas from measurements made from ships. They attribute this to their inability to filter out the signal from diurnal variations in the magnetic field. Such problems would be most serious when surveying large areas or when searching for large geological features. In general, however, the Soviets have made an impressive and diverse effort in marine magnetics, a substantial effort in instrument development, and extensive efforts in geomagnetic surveying and mapping. 25X1

When prospecting for minerals in the shallow ocean (where most ore bodies of commercial interest are located) or when looking for an object such as a submarine at relatively shallow depths, the instrument must be close to the source of the signal. When locating submarines, the area and time factors are still smaller, and changes in the signal because of the source should not be confused with diurnal changes in the background magnetic field. For this type of work, the Soviets have developed a wide variety of good magnetometers and have carried out extensive surveys to provide a large data base for defining the background environmental magnetic noise. This, in turn, would be useful for both ASW and navigation. 25X1

We believe the Soviets will continue their large geomagnetic ocean survey programs, using new and improved instruments as they are developed or as they are obtained from the West. Areas such as ASW and mineral exploration will continue to be driving forces for marine geomagnetic work. 25X1

the Soviets, especially younger scientists, are beginning to be more active in developing the plate tectonic theory. Consequently, we expect them to attack more vigorously their problems in making deepwater observations over large areas. 25X1 25X1

Geologic and Bottom Mapping Research

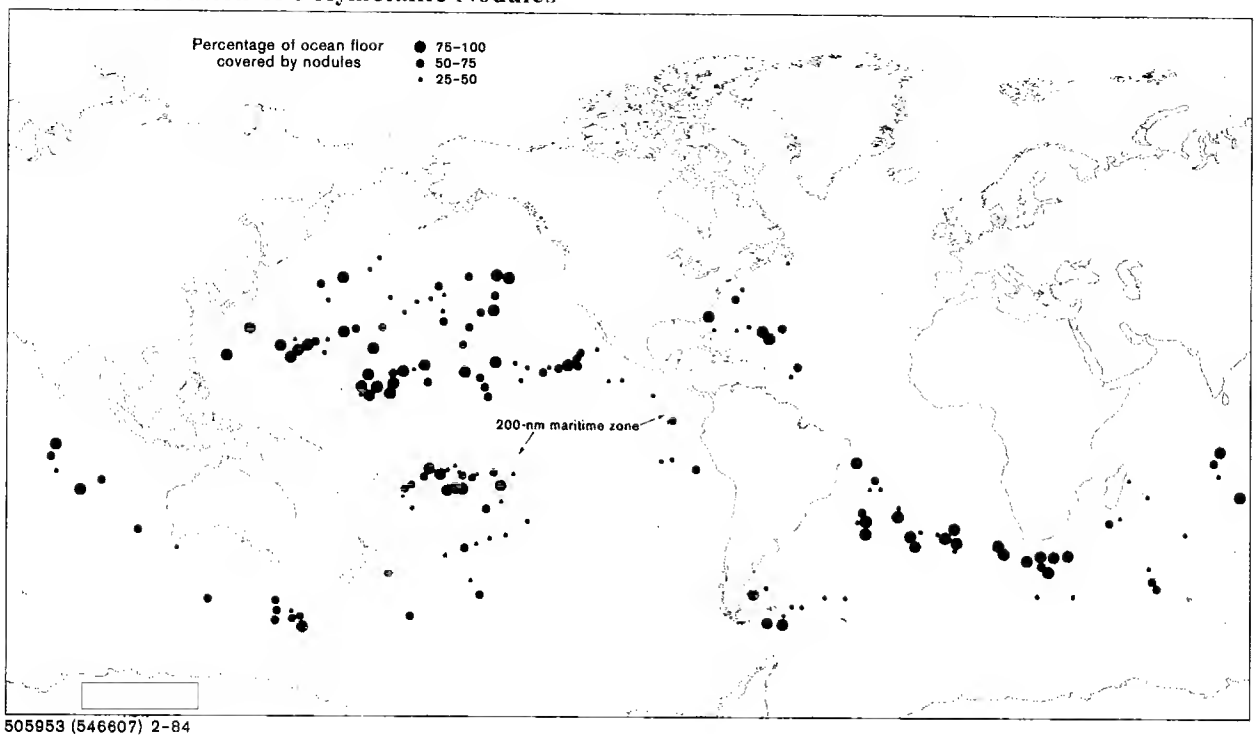
The Soviets have been very active in geologic and bottom-mapping research and generally have produced reasonably high-quality data. Much work has been done concerning the continental shelves, where most mineral wealth—including petroleum—is found. The Soviets also have explored rather extensively for manganese deposits in the deep ocean, as well as other geologically interesting areas such as ocean ridges, rifts, and trenches. 25X1

Scientific literature published by the Soviets shows that they have continued to study ocean sediment throughout the world and have published maps of the bottom sediments of three oceans. They also have studied deposits of polymetallic-sulfide minerals in sediments in rift canyons and fracture zones. They have studied manganese nodule formation and have surveyed these deposits extensively in the Pacific Ocean and, to a lesser extent, in the Indian Ocean and other areas. Although the Soviets have an abundance of the minerals in manganese nodules on Soviet-controlled territory, they clearly would not like to see seabed mining dominated by Western countries (figure 7). 25X1

the Soviets are beginning to use automated multibeam sonar systems for mapping ocean bottoms. With these systems, they can obtain details on the relief and structure of the ocean floor. Such information, if combined with precise locational data, can be valuable for submarine navigation, as well as for geological studies. Relief features can be used to update the inertial navigational system of the submarine, and the updating can be done at operating depths, thus protecting the security of the submarine. For submarines operating under the Arctic icepack, bottom relief data may be the only method available for updating the inertial system. The Soviets are using side-scan sonars to locate and to explore specific geological or manmade ocean-bottom structures through high-resolution, picture-like images of the ocean floor. 25X1 25X1

We expect the active Soviet program in marine geology and bottom mapping to continue, and it probably will be increased as new equipment becomes available. The importance of bottom mapping to submarine navigation, as well as the importance of marine geology to mineral exploration, will ensure continued strong Soviet interest in such research. 25X1

Figure 7
Global Distribution of Polymetallic Nodules



505953 (546607) 2-84

25X1

Hydroacoustics

Military sonar systems are the principal means of detecting submarines and surface ships. Sonars also are used for depth sounding and for navigation, based on bottom-depth contours. Submarines and even surface ships have hydroacoustic communication systems.

25X1

In scientific research, hydroacoustics can be used to study variations in the ocean temperature and salinity structure, indicated by their effects on the long-range transmission of sound. Acoustic triggers are used to release instruments from the sea floor. Acoustic beacons can be used to track drifting instrument buoys and to position ships over instrument and drilling sites. Certain sonars are used by the fishing industry to find schools of fish.

25X1

Hydroacoustics is the one area of oceanographic research performed primarily for military purposes.

Much Soviet hydroacoustic research is directed toward a better understanding of the ocean environment as applied to ocean acoustics. The Soviets use these data to improve their sonar systems, and to develop and test other hydroacoustic systems, including transponders, hydrophones, and signal processors for ASW. See box for a discussion of Soviet research in the Northwest Pacific.

25X1

Soviet research in hydroacoustics has included studies of the following:

- Temperature and salinity at various depths throughout the world, to construct sound velocity profiles. This research assists in modeling and predicting sound propagation ranges, which in turn can be tested by studying sound propagation through the varying seawater media.

Soviet Research in the Northwest Pacific

Every summer since 1978, the Soviets have conducted extensive ocean research in the Northwest Pacific near the Kamchatka Peninsula in support of ASW. This research has involved at least 15 different civilian and military oceanographic research ships, specially equipped aircraft, spacecraft, and possibly submarines. Our analysis indicates that the research involved:

- *Studies of the conditions at ranges up to 1,000 nm from Cluster Lance, the Soviets' new hydroacoustic system for protecting the area around Petropavlovsk against foreign submarine.*
- *Studies of the vertical and horizontal structure of water temperature and salinity and internal waves to understand the phenomena associated with Soviet attempts to develop aircraft and spacecraft sensors capable of finding submerged submarines.*
- *Studies of the ocean fronts, eddies, and vertical temperature structure to better understand hydroacoustics so as to assist Soviet submarine and ASW operations.* 25X1

The Soviets use this area as a relatively secure area for field studies in the development and testing of ASW sensors and operational techniques that may be employed worldwide. In addition, Petropavlovsk must be protected because it is the only unrestricted deepwater access to the open ocean for Soviet naval forces. For these reasons, we believe the studies here have been particularly intense. 25X1

- Effects of sea surface waves on the interaction of underwater sound with the ocean's surface.
- Effects of different sea-floor sediments on sound reflection and refraction.
- Ambient noise from natural sources such as fish, whales, shrimp, storms, and earthquakes, as well as from manmade sources that include ships, oil-rig activities, and explosions.
- Effects on ocean acoustics of ocean features such as currents, eddies, and oceanic fronts. Submarines can use these features to escape detection, or ASW forces can use them to increase the likelihood of detecting a submarine.
- The causes and statistics of sound variation for developing computer models to predict hydroacoustics.
- Reductions in the effectiveness of active sonar caused by reverberation. (Reverberation is the reflection of sound back to the sonar by marine life and particles suspended in seawater.)
- Tests supporting the development of new sonar systems. 25X1

During the last 10 years, the Soviets have made great advances in their knowledge of hydroacoustics. In some areas, their data base may be more extensive than that of the United States, and their ability to develop theoretical models of statistical acoustics apparently is very good. However, 25X1 the Soviets have a shortage of computer resources. This shortage, in some cases, probably has hindered their developing practical hydroacoustic models. 25X1 25X1

Biological Oceanography

Soviet research in biological oceanography covers a broad range of topics, with some applications to the large worldwide Soviet fishing industry and some to the Soviet Navy. The research seems to concentrate on projects with direct and immediate applications to national interests, rather than on those designed primarily to further scientific knowledge. For example, research into fish stocks and the factors affecting them supports the Soviet fishing industry. Such efforts include worldwide surveys of species suitable for food; their life cycles, including reproductive processes; increased productivity; and the food chain of each species. 25X1

The large Soviet fishing and fishery research fleets provide access to many areas of the world, where the Soviets collect data useful to their Navy. The adoption of a 200-mile exclusive economic zone by most countries, however, has limited the fishing areas available to the Soviets. As a result, they are trying to make more efficient use of traditional fish sources, as well as to find new food species and fishing areas. An example is their use of the schools of shrimp-like krill found in Antarctic waters. Because they also are increasing their use of nontraditional marine food sources, the Soviets can be expected to continue to maintain and possibly to expand their fisheries. Expansion of their Pacific Ocean fisheries is likely. The USSR is expected to continue negotiations with small nations such as the Pacific Island nations for fishery agreements allowing access to their waters.

25X1

Some biological oceanography research for the Navy has concerned the use of sea mammals to perform tasks, such as planting explosives or sensors on vessels, defending harbors against divers, or even detecting submarines. We do not believe the Soviets can use marine mammals for these purposes as yet, but such research is continuing.

25X1

Navy-related research includes studies of the characteristics and worldwide distribution of organisms important in acoustics. Some organisms degrade sonar performance by acting as reflectors—thus reducing the range of active sonars—or by acting as false bottom for fathometers. For example, schools of fish and whales can be mistakenly identified as submarine targets. Some fish and crustaceans, such as croakers or snapping shrimp, can produce so much background noise that sonar performance may be greatly degraded. Biofouling organisms—for example, barnacles—can be costly to naval operations. The organisms reduce ship speed and increase fuel costs, destroy piers, and reduce the effectiveness of underwater equipment. The Soviet Navy is conducting research to better understand these organisms and subsequently to develop ways to reduce the damage of biofouling through special coatings and equipment design.

25X1

Of particular interest in ASW are the studies of reduced optical clarity of seawater caused by biological activity, as well as studies of the distribution of bioluminescent organisms that when disturbed under certain conditions can reveal the presence of a shallow submarine.

25X1

Soviet oceanographers also carry out basic studies in the ecology of marine organism communities, including the physiology and biochemistry of marine organisms themselves. The Soviets may lead the United States in efforts to identify useful substances in marine organisms. Many, for example, have medical applications. Future research in this field may provide insight into molecular and cell physiology applicable to humans, and could discover new drugs.

25X1

The Soviets place little emphasis on marine aquaculture, probably because of their cold climate and because they have been fairly successful in meeting their requirements for marine foods with their large fishing fleet. We believe, however, that the Soviets will try to increase their influence with underdeveloped nations in warmer climates by assisting them with marine aquaculture projects.

25X1

25X1

Chemical Oceanography

25X1

Soviet work in chemical oceanography generally lags that of the United States, primarily because of a scarcity of sophisticated automated analytical equipment, although this equipment usually is available in the West. The Soviets have studied environmental pollution and the composition of seawater, as well as natural nutrient and mineral cycles. Soviet oceanographers seem interested in ocean changes brought about by man's pollution, as well as subsequent effects on Soviet fisheries. The Soviets also have participated in international marine pollution research, including some with the United States.

25X1

Soviet researchers have shown interest in methods of extracting valuable minerals dissolved in very low concentrations in seawater. These methods are unlikely to be economically feasible in the near future.

25X1

Soviet Navy programs have studied the natural trace element in seawater to develop methods for sensing

25X1

Western submarines, based on the changes in the chemistry of seawater in their wakes. Most of this research has involved measuring radioactive isotopes formed by the actions of radiation from a nuclear submarine on naturally occurring elements in seawater.

Polar Oceanography

The Arctic always has been important to the Soviets, because it dominates their weather and climate, their food production, and, to a certain extent, their whole way of life. In recent years the Arctic has taken on added significance because of its oil and gas resources. It also has become more important as merchant shipping has increased, and the Northern Fleet—the largest Soviet fleet—is now concentrated around Murmansk, which lies well above the Arctic Circle.

25X1

Our analysis shows that Soviet oceanographic research in the Arctic greatly exceeds the combined efforts of all other nations. Many research aircraft equipped with a variety of remote sensors—including ice-mapping radar—collect data to support Soviet merchant shipping and Navy activities. Since 1937 the Soviets have established 25 research stations on the drifting icepack. In recent years two or three of these stations have been operated year-round as research bases; in spring they also function as airport support bases for wide-ranging oceanographic research over the entire Arctic basin. Also each spring the Navy establishes one or more large temporary camps to conduct hydrographic, acoustic, geomagnetic, gravimetric, and other types of research (figure 8).

25X1

The Arctic icepack stations routinely measure ice salinity, temperature, and depth, as well as make bathymetric and ocean-current observations. Arctic and Antarctic Scientific Research Institute personnel also regularly conduct hydroacoustic studies; often these are carried out jointly with members of the Acoustic Institute of the Academy of Sciences. Personnel from the Scientific Institute of Arctic Geology regularly carry out geomagnetic, gravitational, and seismic research over the outer continental shelf regions of the Arctic in support of the Ministry of Geology.

25X1
25X1

The USSR maintains more stations in Antarctica than any other nation and has been very active in oceanographic research in Antarctic waters, as well. The reasons are not quite so clear-cut as for the Arctic. Some processes in both regions are similar: for example, it is becoming clear that the oceans have global importance for meteorological and climatological purposes. The Antarctic waters also have an abundance of marine life, and there are indications of offshore petroleum and mineral deposits. Strategically, the southern sea lanes could take on greater importance if the Panama and Suez Canals become inoperative. The Soviets also look upon their Antarctic efforts as a means of demonstrating their scientific capabilities and establishing scientific relationships with other countries.

25X1
25X1
25X1

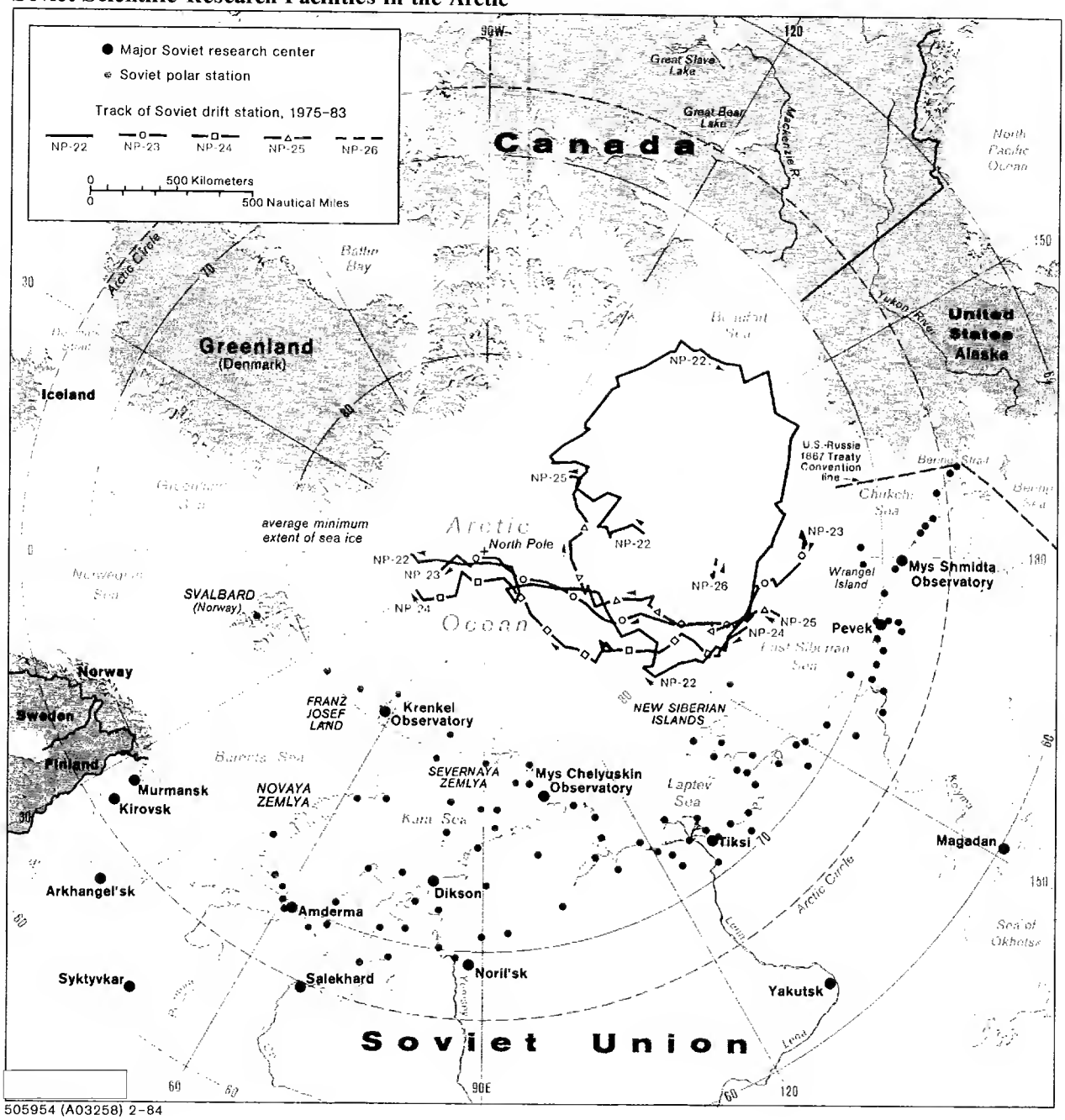
Published scientific research shows that the Soviets have conducted comprehensive oceanographic research in the Antarctic region, largely under the Polex-South program. This work has added significantly to world understanding of the area. Some reported objectives were the heat exchange between oceans and atmosphere, ice conditions and distribution of icebergs, ocean circulation, geological and geophysical phenomena, hydrological conditions, and zonal distribution of fauna in southern oceans. Temperature and salinity measurements, and some sonar and surface-wave observations are made routinely by vessels transiting from home ports to Antarctica.

25X1

We believe that Soviet oceanographic research in both the Arctic and Antarctic regions will continue at an undiminished pace, especially in the Arctic where the Soviets have a large civil and military interest. Because their work in the Antarctic often is driven by political considerations—such as international relations and available funding—their efforts there will be more subject to change.

25X1

Figure 8
Soviet Scientific Research Facilities in the Arctic



505954 (A03258) 2-84

25X1

Bilateral and Multilateral Cooperation

Some oceanographic research requires observations over broad expanses of the world's oceans, in some instances nearly simultaneously. Included are studies of the large-scale interaction of the ocean and atmosphere, as well as monitoring the state and dynamics of the marine environment, investigating the number and distribution of fish populations, and studying the ocean floor to determine the geological history of the earth.

25X1

25X1

in cooperative efforts with the West, the Soviets generally are free about offering their ships. In some cases, Western scientists have been allowed to conduct experiments aboard Soviet ships. In return, the Soviets want to receive Western instrumentation and technical assistance. For example, the Soviets contributed more than two years' ship time to the Polymode, a study of ocean dynamics of the Gulf Stream and Sargasso Sea that was undertaken as part of the US-USSR World Ocean Agreement. In return, the United States provided the USSR with approximately 5,000 expendable bathythermographs—including deployment equipment and recorders—to collect ocean-temperature profiles and hydroacoustic transponders to monitor the positions of other data-collection equipment.

25X1

The Soviets also made significant contributions in ship time to the Global Atmospheric Research Program, which was designed to increase understanding of the relationship between ocean processes and weather. In the Atlantic Tropical Experiment portion of the program, the Soviets provided 12 of the 37 participating ships, and, for the first Global experiment, they provided 11 of 50 vessels.

25X1

The Soviets have other bilateral arrangements, including some with France, Guinea, and some Soviet-aligned nations. Press reports indicate that the agreement with France is comprehensive, including cooperation in the form of joint projects, exchange of scientists and data, and joint conferences in many oceanographic disciplines. The Soviets have built an oceanographic research center for Guinea, ostensibly to train Guinean scientists. At the same time, however, the facility provides Soviet vessels with ready access to the equatorial Atlantic.

25X1

Soviet performance has been spotty in cooperative projects with the United States. Soviet participation in the Joint Oceanographic Institutes Deep Earth Sampling (JOIDES) Project has tended to be passive, with the exception of financial support that started at $1 million annually in 1974 but increased to $2 million in FY 1982. The Soviet contributions in manpower and instrumentation have been useful to the Glomar Challenger project, but they have not been critical to the project's overall success. The Soviets provided scientific staffing for Glomar Challenger cruises, and in 1979, for the first time, they provided instrumentation for a field experiment. The instrument, a down-hole magnetometer for bore hole measurements, performed satisfactorily.

25X1 25X1

US participants in the Polymode Project state that Soviet contributions of ship time and associated personnel were significant. At the same time, Soviet participation was frustrating because Soviet bureaucracy (especially its inflexibility), poor communications, and technical deficiencies impeded the progress and success of the project. In 1976, for instance, the Soviets chose to work separately, 1,500 km north of the US site; a year later they rejoined the US scientists.

25X1

25X1

The Soviets' participation in the Global Atmospheric Research Program probably was one of their better cooperative efforts. in general, the Soviets made every effort to contribute but were unable to meet their commitment to provide a geostationary satellite for the project. At one point they attempted to apply political pressure by threatening to withdraw from the program if the United States would not allow the sale of a CDC-7600 computer to the USSR, but they did not follow through when the sale was denied.

25X1 25X1

Another cooperative effort that generally has involved positive contributions by the Soviets concerned biological productivity and biochemistry of the oceans.

Their collaboration in the International Southern Ocean Studies has been good, and the Weddell Sea Polynya [5] Expedition in the Atlantic shows promise. 25X1

Despite their poor performance in some cooperative efforts, the Soviets undoubtedly value opportunities to enter into such projects with other advanced nations. High-level Soviets frequently have voiced concern that the United States may not continue to be as active in multilateral and bilateral projects as in the past. The Soviets apparently believe that the expensive ship time they contribute is repaid by their increased access to advanced instrumentation and data processing equipment, as well as by obtaining ocean data and acquiring international stature. We believe, therefore, that they will continue to pursue international cooperative projects. 25X1

We believe that the Soviets will continue cooperative projects with lesser developed countries, such as the project in Guinea and a recent unsuccessful attempt to assist a group of nine South Pacific Island nations with research in their waters. Although these types of projects permit the Soviets to collect data in normally restricted areas, the projects also have propaganda value by allowing the Soviets to establish a favorable relationship with participating countries. Such Soviet offers probably will become more attractive to Third World nations as Soviet oceanographic capabilities improve and as increasing expenses force Western nations to reduce their assistance. 25X1

Trends and Implications

The trend in almost all aspects of Soviet oceanography research is expansion, which probably is driven by Navy, as well as civilian, needs to understand, to predict, and to exploit the oceans. A secondary purpose probably is to advance science and thereby to improve the Soviet image. This, in turn, would increase Soviet chances to participate in bilateral and multilateral projects providing access to Western data and facilities, as well as to geographic areas that otherwise might not be open to the Soviets. 25X1

25X1

[5] A *polynya* is an area of clear water enclosed by ice.

The rate of expansion of Soviet oceanographic research is indicated by the number of major civilian projects under way. An Academy of Science report to the 26th Congress of the Communist Party states that during the current five-year plan (1981-85), a total of 38 interdepartmental research projects are scheduled, compared with 16 such projects during the previous five-year plan. Most of the scheduled projects will involve several different ministries and state committees, as well as the Academy of Sciences, which will play a prominent coordination role. 25X1

Some of the new projects are as follows: Project Profiles will involve detailed ocean observations in regions that the Soviets believe strongly affect their weather. Project Dumand will lead to a major experiment in which the ocean will be used to detect muons and high-energy neutrinos reaching the earth from outer space. The Ocean Acoustics Project will do preliminary work to establish systems for acoustic tomography [6] of the ocean. The major Seas of the USSR Project by the State Committee for Hydrometeorology and Control of the Natural Environment will involve detailed investigations of natural resources of the seas and continental shelf areas bordering the USSR. 25X1

These are ambitious programs, and the Soviets may encounter difficulties. The programs should produce a wealth of data that almost certainly will present problems for Soviet data processing systems. Consequently, we believe that publication of analyses of these data will be slow. On the other hand, the Soviets' experience from the large bilateral and multilateral projects such as Polymode and the Global Atmospheric Research Program will aid the Soviets as they organize and carry out these unilateral projects. The enlargement and modernization of the research fleet, expansion of the oceanographic satellite program, and development and acquisition of more sophisticated instrumentation also will contribute to the success of the projects and to the significance of their results. 25X1

[6] Ocean acoustic tomography is the study of ocean features such as fronts, eddies, and currents caused by the effects of varying temperatures and salinity on sound traveling through water. 25X1

As the Soviets expand and improve their oceanographic research program, they probably will become less dependent on cooperative projects with other nations, although many large-scale projects would be extremely difficult and would require enormous expenditures if conducted independently. With their increased capabilities, however, the Soviets will be able to approach negotiations from a stronger position than they now have. They also will be able to provide better oceanographic support to their Navy forces and to important elements of the civil economy. Although no sudden breakthroughs are expected, we believe that progress will be steady, with continued strong support at high governmental levels.

25X1